

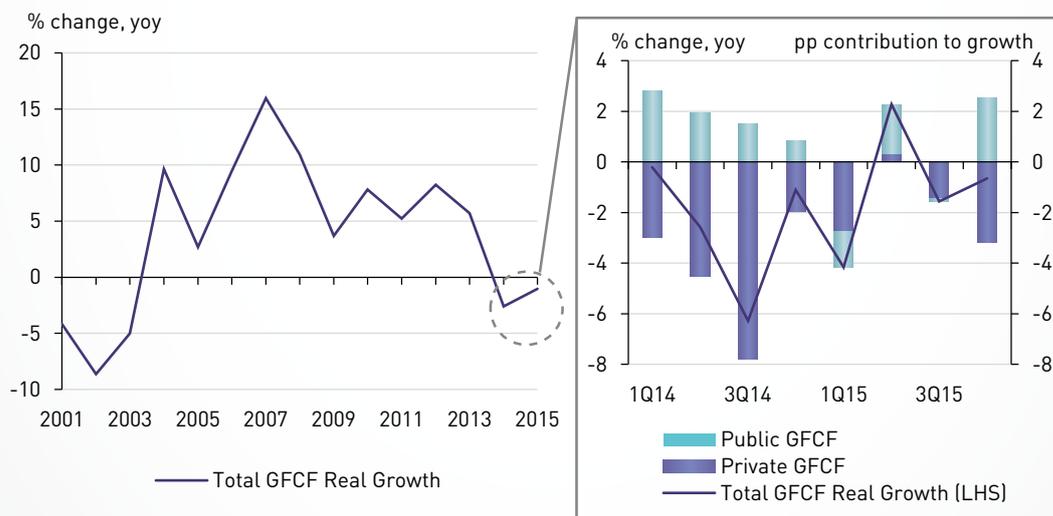
Box 1.1: Recent Trends in Singapore's Real Gross Fixed Capital Formation

This article examines recent trends in Singapore's real gross fixed capital formation (GFCF). We find that the decline in Singapore's real GFCF in 2014 and 2015 was mainly due to a contraction in private GFCF, which could in turn be partly attributed to a decline in private machinery & equipment (M&E) investments. Factors that may explain the decline in private M&E investments include heightened global economic uncertainty, the cyclical downturn in manufacturing, and the shift towards services in the Singapore economy. Using an error correction model, we find that global economic uncertainty was the main contributor to the decline in private M&E investments in Singapore in the last two years, although the latter two factors also contributed to the weakness.

After ten years of growth, real GFCF contracted in 2014 and 2015, mainly due to a decline in private GFCF

Real GFCF contracted by 2.6 per cent and 1.0 per cent in 2014 and 2015 respectively, predominantly due to a fall in private GFCF¹ (Exhibit 1). The weakness in GFCF is of concern for two reasons. First, it weighs on GDP growth in the short-term. Second, a prolonged decline in capital investments would reduce the economy's capital intensity (i.e., capital-labour ratio) and could affect our productivity performance in the longer term.

Exhibit 1: Changes in Real GFCF, 2001 – 2015



Source: Singapore Department of Statistics

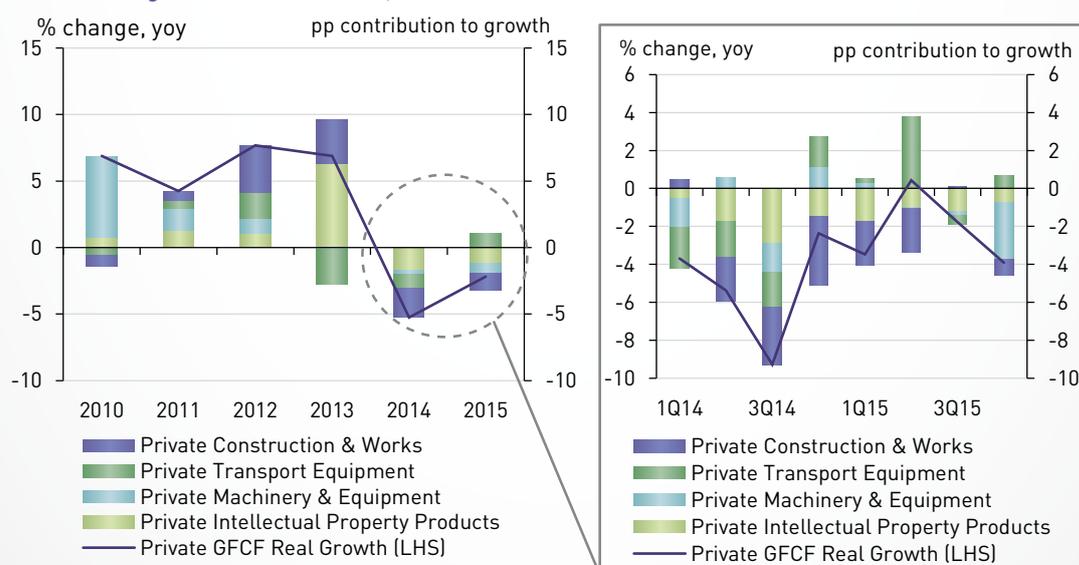
¹ Private GFCF accounts for the bulk of total GFCF. Over the period of 1Q10 to 4Q15, private GFCF accounted for around 80 per cent of total GFCF.

The decline in private GFCF in the last two years could be attributed to broad-based weakness across all key segments of capital investments

Private GFCF fell by 5.2 per cent and 2.2 per cent in 2014 and 2015 respectively, with weakness seen across all key segments of capital investments (Exhibit 2). A brief analysis of the trends for each segment is as follows:

- Private Construction & Works (46 per cent of private GFCF).² Investments in private construction & works declined in all quarters of 2014 and 2015, except for 1Q14 and 3Q15. For the whole of 2014 and 2015, investments in private construction & works fell by 4.9 per cent and 2.9 per cent respectively, with the decline due to a fall in investments in both non-residential and residential buildings. The slowdown in investments in residential buildings was in turn in line with the broader weakness in the residential real estate market.
- Private Intellectual Property Products (18 per cent of private GFCF). Investments in private intellectual property products, which include investments in R&D and software, declined by 8.2 per cent and 5.9 per cent in 2014 and 2015 respectively. The decline can be partly attributed to base effects due to the strong outturn in 2013, as well as a slowdown in R&D investments by businesses amidst sluggish economic conditions in recent years.
- Private Transport Equipment (9 per cent of private GFCF). Investments in private transport equipment, which include items like aeroplanes and ships, tend to be lumpy and volatile. In some quarters, investments in private transport equipment saw double-digit negative growth, followed by double-digit positive growth. For the full year, investments in private transport equipment rose by 14 per cent in 2015, reversing the 13 per cent decline in 2014.
- Private Machinery & Equipment (26 per cent of private GFCF). Private M&E investments fell by 1.3 per cent and 2.7 per cent in 2014 and 2015 respectively. As M&E is an important segment of capital investments which would have a direct impact on firms' capital-labour ratio, we focus on explaining the trends in this segment in the subsequent sections.

Exhibit 2: Changes in Real Private GFCF, 2010 – 2015



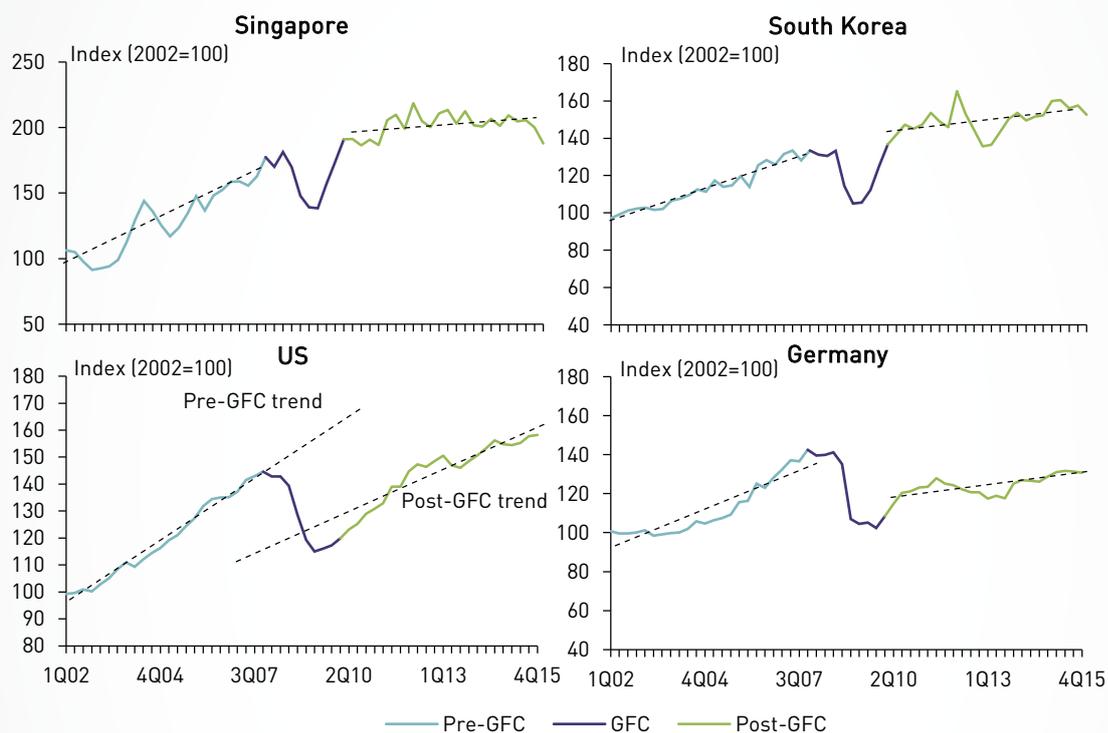
Source: Singapore Department of Statistics

² The shares were taken over the period of 1Q10 to 4Q15.

Many advanced economies have experienced weakness in private M&E investments in recent years

The weakness in private M&E investments is not unique to Singapore. The IMF (2015) noted that many advanced economies have seen a sharp moderation in private investments since the Global Financial Crisis (GFC). Comparing the post-GFC period with the pre-GFC period, Exhibit 3 shows that private M&E investments have weakened in the post-GFC period in economies such as the US, Germany and South Korea.³ We next examine the possible factors that could explain the weakness in private M&E investments in Singapore.

Exhibit 3: Private M&E Investments, by Countries, 2002 – 2015



Source: Singapore Department of Statistics, US Bureau of Economic Analysis, CEIC

Notes: Data series for Singapore and South Korea were seasonally-adjusted using the EViews X-13 seasonal adjustment. Private M&E investments data for Germany includes private transport equipment while for South Korea, the data includes public M&E investments.

Singapore's private M&E investments are influenced by global economic uncertainty

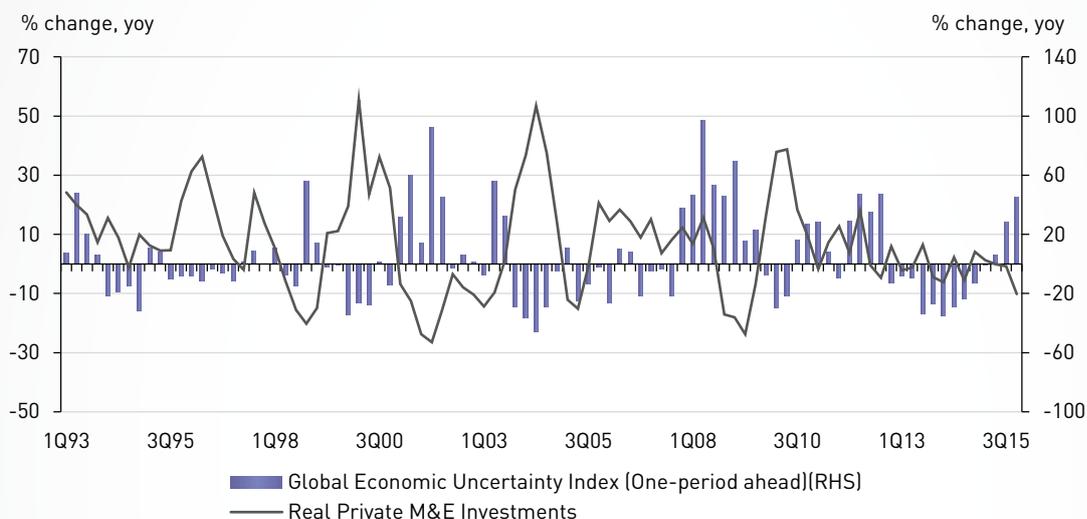
First, we find that Singapore's private M&E investments are influenced by global economic uncertainty. Bernanke (1983) and Dixit and Pindyck (1994) have shown that greater uncertainty generally reduces investments because firms tend to delay their capital investment projects when they are worried and uncertain about future profitability.

³ While the trend in private M&E investments in the post-GFC period may seem weaker in Singapore when compared to these countries, this could be because Singapore as a small, open economy is more susceptible to the impact of global economic uncertainty. Moreover, there could also be Singapore-specific factors affecting private M&E investments in Singapore, including the shift in the composition of the economy towards services. The rest of the article explores the factors causing the weakness in private M&E investments in Singapore.

In recent years, there has been heightened uncertainty globally arising from the weaker-than-expected global economic performance. This can be seen from the global economic uncertainty index that we have constructed using the existing Economic Policy Uncertainty (EPU) indices developed by Baker, Bloom and Davis (2015) for major economies around the world (Exhibit 4).⁴

In line with the evidence in the economic literature, the increased level of global economic uncertainty could have exerted downward pressures on private M&E investments in Singapore, as well as in advanced economies around the world. Specifically, from Exhibit 4, we observe a negative correlation between the global economic uncertainty index and private M&E investments in Singapore, with an increase in uncertainty associated with a fall in private M&E investments.

Exhibit 4: Global economic uncertainty index and private M&E investments



Source: Singapore Department of Statistics, www.PolicyUncertainty.com, MTI Staff Estimates
 Note: The correlation coefficient of the two series is -0.30.

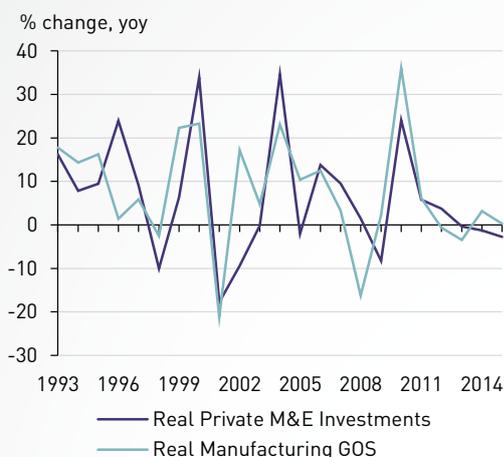
Singapore’s private M&E investments are also correlated with the performance of the domestic manufacturing sector

Second, Singapore’s private M&E investments are correlated with the performance of the manufacturing sector. As can be seen in Exhibits 5 and 6, private M&E investments correlate positively with profit levels (measured by gross operating surplus or GOS) and the output of the manufacturing sector. As such, the recent weak performance of the manufacturing sector⁵ on the back of sluggish global demand would likely have translated into weaker private M&E investments.

⁴ We derive the global economic uncertainty index by weighting the EPU indices for the US, Europe, China and Japan. Each of these countries’ EPU were indexed to 1995 and then weighted by their share of Singapore’s final demand based on the 2011 OECD-WTO Trade in Value-Added (TiVA) database. As the EPU index for China starts from 1995 onwards, we only used the EPU indices for the US, Europe and Japan when constructing the global economic uncertainty index for time periods before 1995.

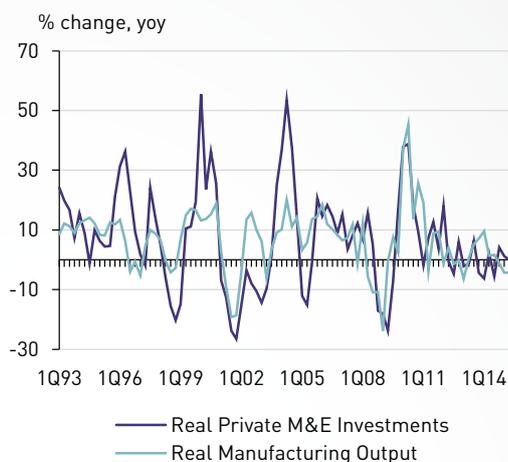
⁵ Singapore’s manufacturing sector is highly exposed to external demand. Any pullback in external demand will reduce the incentive for manufacturing firms in Singapore to invest in M&E to boost their productive capacity since they now have less orders to fulfil. There are a number of reasons why Singapore is currently experiencing weak external demand for its manufactured goods. First, the global economic recovery has been weaker-than-expected. Second, the Chinese economy is slowing down as it rebalances towards consumption and services-led growth. Third, China has increasingly been in-sourcing the intermediate goods required to produce its manufacturing output.

Exhibit 5: Manufacturing GOS and private M&E investments growth



Source: Singapore Department of Statistics
 Note: The correlation coefficient of the two series is 0.65.

Exhibit 6: Manufacturing output and private M&E investments growth



Source: Singapore Department of Statistics
 Note: The correlation coefficient of the two series is 0.60.

Finally, the shift towards services in the economy may also explain longer-term trends in Singapore's private M&E investments

Third, over the longer term, the shift towards less capital-intensive services sectors may affect the rate of private investments in M&E. In particular, data from EDB's Census of Manufacturing and DOS' Survey of Services suggest that the amount of capital (excluding land, buildings and structures)⁶ needed to generate one unit of real value-added is substantially higher in the manufacturing sector than in the services sector. Since the services sector is less capital intensive, we are likely to see lower capital intensity in the economy as the services' share of the economy increases due to the faster growth of services relative to manufacturing. The lower level of capital intensity in the economy may then translate into slower rates of capital investments, including investments in M&E, over time.

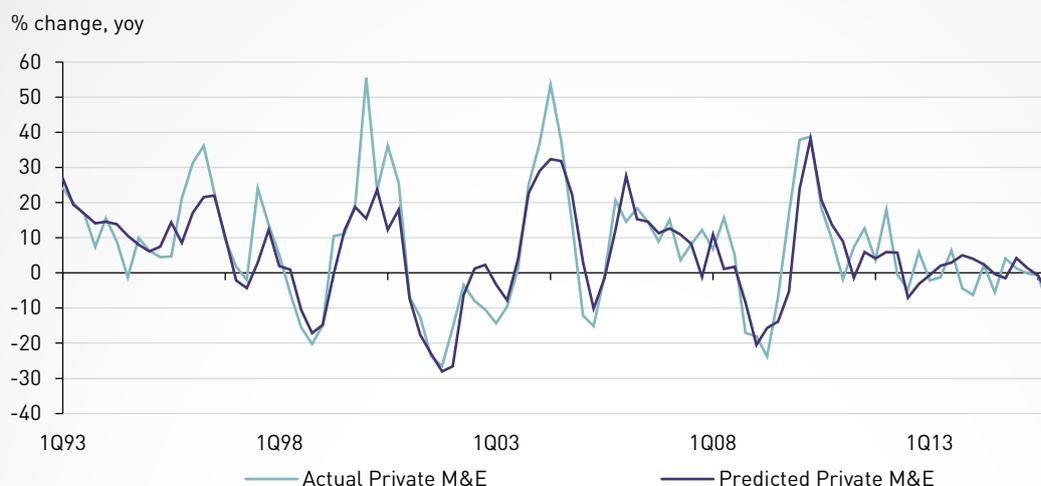
We next estimate an error correction model to quantify the importance of these three factors in explaining the trends in Singapore's private M&E investments

To determine which of the factors highlighted above have had the greatest impact on private M&E investments in Singapore, we estimate an error correction model (ECM) using the global economic uncertainty index, the manufacturing output in Singapore, and the share of manufacturing in the Singapore economy⁷ as explanatory variables. The estimated ECM generally fits the data well and is able to explain over 70 per cent of the total variation in private M&E investments over the period of 1993 to 2015 (Exhibit 7). The details of the ECM are in Annex A.

⁶ Capital is measured by net fixed assets excluding land, building & structures.

⁷ This is used as a proxy for the compositional change in the economy away from manufacturing towards services.

Exhibit 7: Predicted and actual growth in real private M&E investments, Singapore



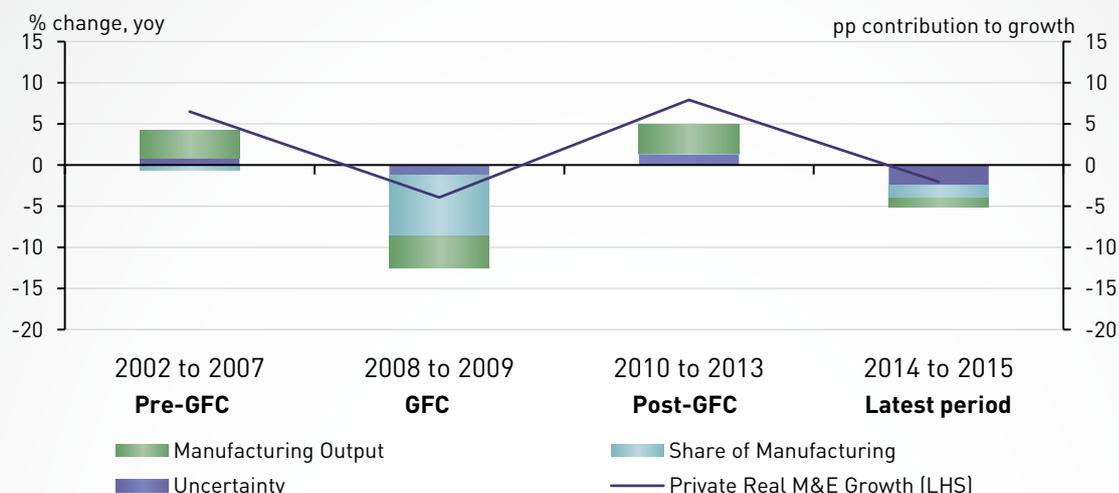
Source: Singapore Department of Statistics, MTI Staff Estimates

Based on the results of the ECM, we find that global economic uncertainty was the main contributor to the decline in private M&E investments, although weak manufacturing output and the fall in manufacturing share also played a role

Using the ECM, we decompose the year-on-year growth rates of private M&E investments into the percentage-point (pp) contribution of each of the three factors over different time periods (Exhibit 8). Our key findings for the more recent time periods are summarised below:

- **Pre-GFC, 2002-2007:** The robust expansion in manufacturing output was the most important factor driving the growth of private M&E investments. During this period, output in the manufacturing sector expanded by 8.8 per cent on average. Relatively subdued levels of global economic uncertainty also contributed positively to growth in private M&E investments. However, the dip in the manufacturing share of the economy from 26 per cent in 2002 to 25 per cent in 2007, arising from the faster growth of less capital-intensive services sectors, posed a drag on the growth of private M&E investments.
- **GFC, 2008-2009:** During the GFC, the fall in manufacturing output (-4.2 per cent in both 2008 and 2009) and the share of manufacturing exerted the biggest drag on private M&E investments, leading to an overall decline in private M&E investments. Elevated uncertainty during this period also played a role in the decline of private M&E investments.
- **Post-GFC, 2010-2013:** The recovery in manufacturing output, especially in 2010, was the most important factor driving the growth of private M&E investments during this period.
- **Latest Period, 2014-2015:** In the latest period, global economic uncertainty was the biggest contributor to the drop in private M&E investments, accounting for 2.5pp of the decline. The fall in manufacturing output and manufacturing share also contributed to the decline in private M&E investments. While manufacturing output expanded by 2.7 per cent in 2014, this was offset by the 5.1 per cent contraction in 2015, resulting in manufacturing output having a net negative contribution to the growth of private M&E investments during this period. Meanwhile, the manufacturing share of the economy fell from 20 per cent on average between 2010 and 2013 to 19 per cent on average in 2014 and 2015.

Exhibit 8: Decomposition of the drivers of private M&E investments



Source: MTI Staff Estimates

Notes: The growth rates and pp contributions were averaged over all the years within each of the time periods. In the chart, the pp contributions of manufacturing output, share of manufacturing and uncertainty do not sum up to overall private M&E investments growth as we did not include the pp contributions from the residual term from the ECM.

In the near term, private M&E investments are likely to continue to face headwinds due to global economic uncertainty, as well as the sluggish outlook for manufacturing

Our analysis has shown that the recent weakness in private M&E investments is a phenomenon not unique to Singapore. We have identified global economic uncertainty as the main contributor to the decline in Singapore’s private M&E investments in 2014 and 2015, although the weak manufacturing output and decline in the manufacturing share of the economy also contributed to the weakness.

Given continued uncertainties in the global economy, as well as the sluggish outlook for the manufacturing sector amidst weak global demand, downward pressures on private M&E investments are likely to remain in the near term.

On its part, the government will continue to help firms automate and invest in productivity-enhancing equipment through the various schemes already in place, such as the Capability Development Grant and the Innovation & Capability Voucher, in order to improve productivity in the economy. By leveraging on these schemes, firms can improve their competitiveness and position themselves for growth when the global economy recovers. At the same time, the government will ensure that the manufacturing sector continues to attract high-value added investments and remain a key pillar of the economy, even as key outward-oriented services sectors continue to expand.

Contributed by:
Economics Division
Ministry of Trade and Industry

Annex A

We first estimate a long-run co-integrating relationship between private M&E investments, manufacturing output, and the share of manufacturing, controlling for the price of M&E.⁸

$$\ln(M\&E)_t = \alpha + \beta_1 \ln(Mfg)_t + \beta_2 \ln(MfgShare)_t + \beta_3 \ln(Price)_t + \theta_t$$

where

$\ln(M\&E)_t$ is the log of real private M&E investments in quarter t

$\ln(Mfg)_t$ is the log of real manufacturing output in quarter t

$\ln(MfgShare)_t$ is the share of manufacturing in the economy in quarter t

$\ln(Price)_t$ is the log of the relative price of private M&E in quarter t

We estimate this long-run relationship using quarterly data from 1Q93 to 4Q15. The coefficients of the regression are reported in Exhibit A1.⁹

Exhibit A1: Coefficient estimates from the long-run co-integrating relationship

Dependent Variable: $\ln(M\&E)_t$	Coefficient
$\ln(Mfg)_t$	0.33**
$\ln(MfgShare)_t$	0.48***
$\ln(Price)_t$	-1.27***
Adjusted R ²	0.92
Period of analysis	1Q93 to 4Q15
Number of observations	92

* p<0.1, ** p<0.05, *** p<0.01

We next model the short-run dynamics using an error correction model (ECM). As uncertainty is likely to play a key role in investment decisions in the short run, we also include the global economic uncertainty index which we had constructed as an explanatory variable to explain the short-run dynamics:

$$\begin{aligned} \Delta \ln(M\&E)_t = & \gamma + \tau_t + \omega \Delta \ln(M\&E)_{t-1} + \delta \Delta \ln(Mfg)_t + \pi \Delta \ln(Uncertainty)_{t-1} \\ & + \mu [\ln(M\&E)_{t-4} - \alpha - \beta_1 \ln(Mfg)_{t-4} - \beta_2 \ln(MfgShare)_{t-4} - \beta_3 \ln(Price)_{t-4}] + \varepsilon_t \end{aligned}$$

Where

τ_t are quarter dummies

$\Delta \ln(M\&E)_t$ is the year-on-year growth of private M&E investments; in particular, $\Delta \ln(M\&E)_t = \ln(M\&E)_t - \ln(M\&E)_{t-4}$

$\Delta \ln(M\&E)_{t-1}$ is the one quarter lagged year-on-year growth of private M&E investments; in particular, $\Delta \ln(M\&E)_{t-1} = \ln(M\&E)_{t-1} - \ln(M\&E)_{t-5}$

$\Delta \ln(Mfg)_t$ is the year-on-year growth of the manufacturing sector's output

$\Delta \ln(Uncertainty)_{t-1}$ is the one quarter lagged year-on-year change in the global economic uncertainty index which we constructed by weighting existing Economic Policy Uncertainty (EPU) indices for major economies that were developed by Baker, Bloom and Davis (2015)

⁸ This framework is adapted from the accelerator model of investment. See for example, Oliner, Rudebusch, and Sichel (1995), Lee and Rabanal (2010), Barkbu et. al (2015) and IMF (2015).

⁹ Having estimated the long-run relationship, we used an augmented Dicky-Fuller test on the residuals to check for the presence of unit root. As the test found no evidence of a unit root, this implies that a long-run co-integrating relationship exists.

The regression results from the ECM show that all the explanatory variables were statistically significant and correctly signed (Exhibit A2). As shown, this model has an R² of 0.71 which implies that it can explain over 70 per cent of the movements in private M&E investments.

Exhibit A2: Coefficient estimates from the error correction model

Dependent Variable: $\Delta \ln(M\&E)_t$	Coefficient
$\Delta \ln(M\&E)_{t-1}$	0.42***
$\Delta \ln(Mfg)_t$	0.38***
$\Delta \ln(Uncertainty)_{t-1}$	-0.07*
Error correction term ¹⁰	-0.58***
Adjusted R ²	0.71
Period of analysis	1Q93 to 4Q15
Number of observations	92

* p<0.1, ** p<0.05, *** p<0.01

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¹⁰ The error correction term refers to: $\ln(M\&E)_{t-4} - \alpha - \beta_1 \ln(Mfg)_{t-4} - \beta_2 \ln(MfgShare)_{t-4} - \beta_3 \ln(Price)_{t-4}$

